

CLAIMS

We claim:

- 5 1. A composition comprising a charge tag attached to a terminal end of a nucleic acid molecule, said charge tag comprising a phosphate group and a positively charged moiety.
2. The composition of Claim 1, wherein said charge tag further comprises a
10 dye.
3. The composition of Claim 2, wherein said dye is positioned between said nucleic acid and said positively charged moiety.
- 15 4. The composition of Claim 2, wherein said positively charged moiety is positioned between said nucleic acid and said dye.
5. The composition of Claim 1, wherein said charge tag further comprises a second positively charged moiety.
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6. The composition of Claim 1, wherein said charge tag has a net positive charge of 1 at pH 6-10.
7. The composition of Claim 1, wherein said charge tag has a net positive
25 charge of 2 at pH 6-10.
8. The composition of Claim 1, wherein said charge tag further comprises one or more nucleotides.

9. The composition of Claim 8, wherein said nucleic acid molecule comprises a sequence complementary to a target nucleic acid, wherein said one or more nucleotides of said charge tag are not complementary to said target nucleic acid.

5 10. The composition of Claim 1, wherein said nucleic acid comprises a first portion complementary to a target nucleic acid and a second portion that is not complementary to said target nucleic acid, wherein said second portion comprises said terminal end.

10 11. The composition of Claim 1, wherein said nucleic acid and said charge tag have a combined net neutral charge and wherein said charge tag has a net positive charge.

15 12. The composition of Claim 1, wherein said nucleic acid and said charge tag have a combined net negative charge and wherein said charge tag has a net positive charge.

13. The composition of Claim 1, wherein said charge tag contains a primary amine.

20 14. The composition of Claim 1, wherein said charge tag contains a secondary amine.

25 15. The composition of Claim 1, wherein said charge tag contains a tertiary amine.

16. The composition of Claim 1, wherein said charge tag contains an ammonium group.

30 17. The composition of Claim 1, wherein said charge tag further comprises a positively charged phosphoramidite.

18. The composition of Claim 1, wherein said charge tag further comprises a neutral phosphoramidite.

19. A composition comprising a positively charged phosphoramidite.

20. The composition of Claim 19, wherein said phosphoramidite comprises a primary amine group.

21. The composition of Claim 19, wherein said phosphoramidite comprises a secondary amine group.

22. The composition of Claim 19, wherein said phosphoramidite comprises a tertiary amine group.

23. The composition of Claim 19, wherein said phosphoramidite comprises an ammonium group.

24. The composition of Claim 19, wherein said phosphoramidite has a net positive charge of one.

25. The composition of Claim 19, wherein said phosphoramidite has the structure:



wherein, X is a reactive phosphate group and Y is a protected hydroxyl group.

26. A composition comprising a nucleic acid molecule, said nucleic acid molecule comprising a positively charged phosphoramidite.

27. A composition comprising a charge tag attached to a terminal end of a nucleic acid molecule, said charge tag comprising a positively charged phosphoramidite.

28. The composition of Claim 27, wherein said positively charged phosphoramite comprise an amine group, wherein said amine group is not further attached to another molecule.

29. A composition comprising a neutrally charged phosphoramidite, wherein said neutrally charged phosphoramidite comprises a nitrogen-containing chemical group selected from the group consisting of secondary amine, tertiary amine, and ammonium groups.

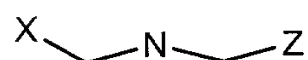
30. The composition of Claim 29, wherein said composition further comprises a nucleic acid molecule attached to said neutrally charged phosphoramidite.

31. The composition of Claim 30, wherein said nucleic acid molecule is attached to a charge tag comprising said neutrally charged phosphoramidite.

32. The composition of Claim 30, wherein said charge tag further comprises a positively charged phosphoramidite.

33. The composition of Claims 32, wherein said charge tag has a net positive charge.

34. The composition of Claim 29, wherein said phosphoramidite has the structure:



wherein X is a protected hydroxyl group, Z is a reactive phosphate, and N comprises an amine group.

35. The composition of Claim 34, wherein N is $N-(CH_2)_nCH_3$, wherein n is 0 or a positive integer from 1 to 12.

5 36. A composition comprising a solid support attached to a charge tag, said charge tag comprising a positively charged moiety and a reactive group configured to allow said charge tag to covalently attach to a nucleic acid molecule.

10 37. A composition comprising a fluorescent dye directly bonded to a phosphate group, wherein said phosphate group is directly bonded to an amine group.

38. The composition of Claim 37, wherein said composition comprises a charge tag, wherein said fluorescent dye is contained within said charge tag.

15 39. The composition of Claim 37, wherein said fluorescent dye comprises Cy3.

20 40. A mixture comprising a plurality of oligonucleotides, each oligonucleotide attached to a different charge tag, each of said charge tags comprising a phosphate group and a positively charged moiety.

41. The mixture of Claim 40, wherein said plurality of oligonucleotides comprises four or more oligonucleotides, each attached to a different charge tag.

25 42. The mixture of Claim 40, wherein said plurality of oligonucleotides comprises ten or more oligonucleotides, each attached to a different charge tag.

43. The mixture of Claim 40, wherein said plurality of oligonucleotides comprises twenty or more oligonucleotides, each attached to a different charge tag.

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77. The method of Claim 72, wherein said plurality of charge-balanced oligonucleotides comprise fifty or more charge-balanced oligonucleotides comprising different charge tags.

78. The method of Claim 72, wherein said conditions comprise treating said charge-balanced oligonucleotide with a reactant.

79. The method of Claim 72, wherein said charge tags are attached to terminal ends of said plurality of oligonucleotides, said charge tags comprising a phosphate group and a positively charged moiety.

80. The method of Claim 72, wherein said charge tags comprise a dye.

81. The method of Claim 72, wherein said charge tags comprise a positively charged phosphoramidite.

82. The method of Claim 72, wherein said charge tags comprise a neutral phosphoramidite.

83. The method of Claim 72, wherein said separating comprises capillary electrophoretic separation.

84. The method of Claim 72, wherein said separating comprises capillary zone electrophoretic separation.

85. The method of Claim 72, wherein said separating occurs in a microchannel.

70. The method of Claim 51, wherein said separating comprises capillary zone electrophoretic separation.

5 71. The method of Claim 51, wherein said separating occurs in a microchannel.

72. A method of separating nucleic acid molecules, comprising the steps of:
a) treating a plurality of charge-balanced oligonucleotides, each
10 containing different charge tags, under conditions such that two or more charge-unbalanced oligonucleotides containing said charge tags are produced, wherein said charge-unbalanced oligonucleotides are contained in a reaction mixture; and
b) separating said charge-unbalanced oligonucleotides from said reaction
15 mixture.

73. The method of Claim 72, wherein said separating comprises separating said charge-unbalanced oligonucleotides such that charge-unbalanced oligonucleotides containing different charge tags are separated from one another.
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74. The method of Claim 72, wherein said plurality of charge-balanced oligonucleotides comprise four or more charge-balanced oligonucleotides comprising different charge tags.

25 75. The method of Claim 72, wherein said plurality of charge-balanced oligonucleotides comprise ten or more charge-balanced oligonucleotides comprising different charge tags.

76. The method of Claim 72, wherein said plurality of charge-balanced
30 oligonucleotides comprise twenty or more charge-balanced oligonucleotides comprising different charge tags.

complementary to said target nucleic acid, wherein said second portion comprises said terminal end.

61. The method of Claim 51, wherein said charge-balanced oligonucleotide
5 has a net neutral charge and wherein said charge-unbalanced oligonucleotide has a net positive charge.

62. The method of Claim 51, wherein said charge-balanced oligonucleotide
10 has a net negative charge and wherein said charge-unbalanced oligonucleotide has a net positive charge.

63. The method of Claim 51, wherein said charge tag contains a primary amine.

64. The method of Claim 51, wherein said charge tag contains a secondary amine.

65. The method of Claim 51, wherein said charge tag contains a tertiary amine.

66. The method of Claim 51, wherein said charge tag contains an ammonium group.

67. The method of Claim 51, wherein said charge tag comprises a positively
25 charged phosphoramidite.

68. The method of Claim 51, wherein said charge tag comprises a neutral phosphoramidite.

69. The method of Claim 51, wherein said separating comprises capillary
30 electrophoretic separation.

- b) separating said charge-unbalanced oligonucleotide from said reaction mixture.

52. The method of Claim 51, wherein said conditions comprise treating said charge-balanced oligonucleotide with a reactant.

53. The method of Claim 51, wherein said charge tag is attached to a terminal end of said oligonucleotide, said charge tag comprising a phosphate group and a positively charged moiety.

54. The method of Claim 51, wherein said charge tag comprises a dye.

55. The method of Claim 54, wherein said dye is positioned between said oligonucleotide and said positively charged moiety.

56. The method of Claim 54, wherein said positively charged moiety is positioned between said oligonucleotide and said dye.

57. The method of Claim 53, wherein said charge tag further comprises a second positively charged moiety.

58. The method of Claim 51, wherein said charge tag comprises one or more nucleotides.

59. The method of Claim 58, wherein said oligonucleotide comprises a sequence complementary to a target nucleic acid, wherein said one or more nucleotides of said charge tag are not complementary to said target nucleic acid.

60. The method of Claim 53, wherein said oligonucleotide comprises a first portion complementary to a target nucleic acid and a second portion that is not

44. The mixture of Claim 40, wherein said plurality of oligonucleotides comprises fifty or more oligonucleotides, each attached to a different charge tag.

45. The mixture of Claim 40, wherein said charge tags comprise a dye.

46. The mixture of Claim 40, wherein said charge tags comprise a second positively charged moiety.

47. The mixture of Claim 40, wherein said charge tags further comprise one or more nucleotides.

48. The mixture of Claim 40, wherein each of said oligonucleotides attached to a charge tag have a combined net neutral charge and wherein said charge tag has a net positive charge.

49. The mixture of Claim 40, wherein each of said oligonucleotides attached to a charge tag have a combined net negative charge and wherein said charge tag has a net positive charge.

50. The mixture of Claim 40, wherein said charge tags comprise a positively charged phosphoramidite.

51. The mixture of Claim 40, wherein said charge tags comprise a neutral phosphoramidite.

52. A method of separating nucleic acid molecules, comprising the steps of:
a) treating a charge-balanced oligonucleotide containing a charge tag under conditions such that a charge-unbalanced oligonucleotide containing said charge tag is produced, wherein said charge-unbalanced oligonucleotide is contained in a reaction mixture; and